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SHORT COMMUNICATIONS

Characteristics of foraging perches used by breeding Bald Eagles in Montana.—Bald Eagles (*Haliaeetus leucocephalus*) spend most daylight hours perching (Steenhof et al. 1980, BioSystems Analysis 1985, Stalmaster 1987). Important attributes of a preferred perch may include proximity to potential prey, isolation from disturbance, good visibility of surrounding terrain, and accessibility for landing and departing (Stalmaster 1987). Perch use has been documented frequently for wintering and migrating Bald Eagles (e.g., Stalmaster and Newman 1979, Hansen and Bartelme 1980, Steenhof et al. 1980, Grubb and Kennedy 1982). Chester et al. (1990) described perches used by nonbreeding summer residents. There have been few studies of perch selection by nesting Bald Eagles (BioSystems Analysis 1985, Grubb et al. 1988, McGarigal et al. 1991).

During the 1985–1988 nesting seasons, we examined characteristics of foraging perches in the three active Bald Eagle breeding territories in Glacier National Park (GNP), Montana. Frequently used and potential but unused perches were compared on two levels: site and tree. We assumed that an eagle first chose an area, or site, in which to perch, and then selected a specific perch tree at that site. Johnson (1979) discussed this type of increasing specificity in habitat selection. We compared characteristics of used perches (site and tree) with available perches to determine if preference for certain perch types existed.

Study area.—GNP (48°30′N, 114°00′W) encompasses 410,200 ha. Forested areas have not been heavily impacted by logging. There were six known Bald Eagle territories in GNP during our study; each nest was within 0.5 km of an oligotrophic lake covering 360 to 2760 ha. We studied territories at Lake McDonald (2760 ha) and Logging Lake (445 ha), both near the headwaters of the Columbia River, and Waterton Lake (1347 ha), in the Hudson Bay drainage. The Lake McDonald shoreline is occupied by numerous private homes and recreational facilities, concentrated at all third order stream inlets and at the outlet. A highway borders one shore, where trees in several eagle-foraging areas were cut to provide scenic vistas. Logging Lake, 6 km from the nearest road, has minimal backcountry facilities. The U.S.–Canada border bisects Waterton Lake. A road and townsite are near the outlet, in Canada, and a visitor-use complex is situated at the Waterton River inlet in the U.S.

Predominant tree species occurring in eagle-use areas are western larch (*Larix occidentalis*), Douglas-fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), black cottonwood (*Populus trichocarpa*), lodgepole pine (*Pinus contorta*), western white pine (*Pinus monticola*), Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), western hemlock (*Tsuga heterophylla*), and paper birch (*Betula papyrifera*) (Habeck 1970).

Methods.—During 6508 observation hours we recorded adult Bald Eagle activities, including perch locations and perch durations. Observation periods ranged from 2 to 16.5 h per day. Perches used more than twice were considered frequently used. Less frequently used perches were excluded from analyses to avoid sampling perch use that may have been incidental. Because nests were at least 300 m from lakeshores, where most foraging occurred, we excluded perches proximate to nests from analyses of foraging perches.

Designating the perch tree as the center of the perch site, we measured the distance from each perch site to the nest, main inlet, nearest lake tributary, trail, campground, and building, using a Numonics digitizer and U.S. Geological Survey 7.5′ quadrangle maps. At Waterton, the nest was associated with the second largest inlet rather than with the main inlet as at the other lakes; therefore, we also measured the distance to the "nest inlet" from each perch in the Waterton territory. At McDonald we measured distance to the lakeshore road; roads nearest to Waterton and Logging were too far (5 to 11 km) to influence observed eagle-foraging areas. We used lake depths as indices of prey (fish) availability. Using U.S. Fish and Wildlife Service (1980) bathymetric maps, we determined depth (categorized into 6.1 m intervals) at distances of 50 and 100 m from shore nearest each perch for McDonald and Logging (not available for Waterton). We then measured all variables for 100 randomly selected control sites at each lake.

Values used in statistical analyses of perch sites were weighted by the proportion of total perching time spent at each site. We determined median and range for distance variables at perch and control sites for each territory. Spearman rank correlation (r_s) between variables for random sites at each territory were used to aid in interpreting results. Because intensity of human use varied greatly among lakes, we analyzed perch site variables separately for each territory.

We recorded six variables for each perch tree: (1) distance to shore, (2) dbh, (3) height, (4) species, (5) structure class, and (6) percent screening (percent of area between the perch and lakeshore that had vegetation ≥3 m high: 0 = 0–25%, 50 = 26–75%, 100 = 76–100%). Tree structure classes were (1) intact snags, (2) broken snags, (3) broken-top live, (4) dead-top live, and (5) totally live. Species selection may be influenced by structure and dbh; therefore, for analysis by species we divided trees into two categories by dbh: small (≤50 cm) and large (>50 cm).

Perch trees were compared with available trees by randomly selecting 10 of the identified perches in each territory and recording the same variables for the 10 trees nearest each randomly selected perch. We used these 10 nearest trees as controls to maximize the chance of sampling the group from which the perch was selected. Control trees were within the same minimum height, dbh, and maximum distance from shore as perches at the same lake. We ranked all trees (perch and controls) at each site from lowest (1) to highest (11) for height and dbh.

We used simulation to test the observed selection against a model or random selection. In the simulation, a tree was selected randomly from the perch and control trees at each site and summary statistics computed for these 30 randomly selected trees. This was repeated 25,000 times. We estimated the expected value of each summary statistic and the probability of obtaining a result as far from expected as was observed.

Results.—Eagles perched 98% of observed time. Eighty-five percent of all perches (N = 94) were at frequently used lakeshore foraging sites. Some sites received a large proportion of foraging perch use (e.g., one site at Logging had 55%). At McDonald, median distances from perch sites to nest, main inlet, building, and tributary were less than from random sites; median distances to trail, road, and campground were greater (Table 1). There were relatively large positive correlations ($r_s > 0.4$) among the first four variables; trail and campground distances were negatively correlated with these four ($-0.8 \leq r_s \leq -0.1$).

At Logging, median distances from perch sites to nest, main inlet, building, and campground were less than from random sites, and median distances to trail and tributary were nearly identical. There were large positive correlations among all variables ($r_s > 0.5$) except distance to tributary. At Waterton, median distances from perch sites to nest and nest inlet were less than from random sites, and distances to trail, tributary, main inlet and building were greater. Median distance to campground was similar for perch and random sites. Distances to nest and nest inlet were negatively correlated or nearly uncorrelated with all other variables ($-0.9 \leq r_s \leq 0.1$), and were positively correlated with one another ($r_s = 0.7$).

Lake depths near perch sites were considerably less than near random sites at McDonald and Logging ($P < 0.001$, chi-square test). Eighty-nine percent of perch times occurred at sites where lake depth 50 m from shore was shallow (<6.1 m); depth was shallow at only 57% of random sites. Seventy-eight percent of perching occurred at sites with shallow depths at 100 m from shore; depth was shallow at only 34% of random sites.

TABLE 1

DISTANCES (M) FROM BALD EAGLE PERCH SITES AND RANDOM SITES AT THREE NESTING TERRITORIES IN GLACIER NATIONAL PARK, MONTANA, 1985–1988. PERCH SITE VALUES WEIGHTED BY TIME SPENT AT EACH PERCH

	Territory					
	McDonald		Logging		Waterton	
Distance to[a]	Median	Range	Median	Range	Median	Range
Nest						
Perch	2290	450–4010	220	200–1820	800	450–2950
Random	2460	360–4530	880	260–2220	1670	420–2970
Tributary						
Perch	90	20–1730	160	0–580	360	20–600
Random	500	10–3840	170	10–600	170	30–710
Main Inlet						
Perch	290	80–4160	150	0–1490	2460	90–3560
Random	2480	130–5770	560	40–1910	1910	70–4500
Nest Inlet						
Perch					1030	60–3360
Random					1480	30–3400
Trail						
Perch	430	60–1290	420	10–790	1060	20–1300
Random	260	10–1110	410	0–850	200	0–1210
Campground						
Perch	2920	20–3620	250	20–1270	1520	430–2610
Random	1850	0–3870	630	30–1310	1470	40–2810
Building						
Perch	140	20–1870	400	170–1630	1540	40–2350
Random	360	0–3510	540	60–1960	1170	20–2400
Road						
Perch	280	20–780				
Random	110	0–2460				

[a] All differences between median values for perch and random sites are significant at the 0.001 level (sign test) except distance to tributary ($P = 0.76$) and trail ($P = 0.99$) at Logging Lake and distance to campground ($P = 0.92$) and building ($P = 0.002$) at Waterton Lake.

Six tree species were used as perches; most were totally live or snags (Table 2). Dbh ranged from 22 to 159 cm ($\bar{x} = 67.1 \pm$ [SD] 29.9 cm). Distance to shore varied from 0 to 60 m ($\bar{x} = 7 \pm 11.7$ m), and tree height ranged from 6.5 to 47 m ($\bar{x} = 23.8 \pm 9.8$ m).

For the 30 randomly selected perches, mean height rank was higher than the expected mean rank (six) under the random selection model ($\bar{x} = 7.3$, $P = 0.022$) for all territories combined. When analyzed separately, however, perch tree rank at McDonald was slightly lower ($\bar{x} = 5.5$, $P = 0.60$). Perch dbh ranked significantly higher than expected ($\bar{x} = 9.4$, P

TABLE 2

RELATIVE FREQUENCIES (%) OF 94 PERCH TREES AND OF A SUBSET OF 30 RANDOMLY SELECTED PERCH TREES FOR SPECIES, STRUCTURE, AND LAKESHORE SCREENING FOR THREE BALD EAGLE TERRITORIES IN GLACIER NATIONAL PARK, MONTANA, 1985–1988. EXPECTED DISTRIBUTION AND *P*-VALUE ESTIMATED UNDER RANDOM SELECTION MODEL BY SIMULATION

	94 perches	30 randomly selected perches		
Characteristic	Observed	Observed	Expected	P^a
Species				
Douglas-fir	28	33	20	0.047
Black cottonwood	29	27	13	0.002
Engelmann spruce	19	17	27	0.13
Lodgepole pine	10	13	6	0.050
Western larch	11	10	8	0.67
Subalpine fir	0	0	11	0.018
Western hemlock	0	0	7	0.18
Paper birch	0	0	4	0.38
Western red cedar	0	0	3	0.52
Western white pine	4	0	2	0.65
Structure				
Snag	30	37	4	<0.001
Dead-top or broken-top, live	14	20	2	0.004
Totally live	56	43	94	<0.001
Screening				
0%	46	60	23	<0.001
50%	6	13	16	0.79
100%	24	27	61	<0.001
Unknown	23			

[a] Probability under random selection that relative frequency would be as different from expected as observed.

< 0.001). This difference persisted even after adjusting for screening and structure. Thus, the high dbh rank of perch trees cannot be explained by an association with these other variables. As mean dbh and height of all trees increased from lake to lake, difference in ranks of perches and controls decreased.

Douglas-fir, black cottonwood, and lodgepole pine were used more than expected (Table 2). All other species except western larch were used less than expected. Snags, dead-top, and broken-top live trees were used substantially more and totally live trees substantially less than expected. This pattern was consistent even when controlling for size (dbh) and species. Where totally live trees were used and other structure types were present, the perch was either a Douglas-fir or black cottonwood which was taller, had larger dbh, and/or was much closer to shore.

Within the small tree category, 13% (5/38) of snag or dead-top and 1% (2/93) of totally live trees were used. Within the large tree category, 50% (12/24) of snag or dead-top and 17% (11/63) of totally live trees were used. Among small trees, lodgepole pine was preferred.

Douglas-fir, black cottonwood, and Engelmann spruce were preferred among large trees and were the only species of totally live trees used. Unscreened trees were used substantially more than expected and fully screened trees less. Unscreened perches tended to be shorter (median height = 26.5 m for screening = 100%; median height = 27.2 m for screening = 50%; median height = 19 m for screening = 0%).

Discussion.—Distances between perches and nests were relatively short at Logging and Waterton, probably because eagles tend to locate nests near favorable foraging sites. At McDonald, human activity along much of the shore may have prevented placement of the nest near a favored foraging location (Fraser et al. 1985, Yates 1989).

Intense human use of the main inlet at Waterton excluded nesting and most perching. An average of 380 people daily visited the facilities at this location during the 1987 summer season, when most observations were made. The nest and foraging locations probably shifted to the undeveloped secondary inlet when human use of the main inlet increased several decades ago. Although intensity of human use at the main inlets of the other lakes was not quantifiable, it was much lower (pers. obs.). Distance to tributary may have been less important at Logging and Waterton, where tributaries were more abundant and all perch and random sites were close to a tributary.

Many lakes in the mountains of the western United States are oligotrophic, with low productivity and few littoral areas. Where shallows do occur, fish tend to be more concentrated, visible, and accessible to eagles. Haywood and Ohmart (1986) stressed the dependance of inland breeding Bald Eagles on benthic-feeding fish and the relationship of nest-site selection to physical characteristics of the stream bottom. McGarigal et al. (1991) also found that foraging areas on the Columbia River were associated with shallow water. Association of perch sites with relatively shallow areas of lakes was evident in our study. We believe that perch proximity to shallow water is very important at deep water lakes. Overall, the most consistent differences we found between random and perch sites were related to foraging opportunities of the site (lake depth and distance to inlet or tributary) and to distance to nest. Inconsistencies among lakes in distances from perches to human development may be due to correlations with more important variables and/or variation in type and intensity of human use at the lakes. Eagles did not seem to avoid the facilities at Logging, where there was less human activity. At McDonald and Waterton, human activity varied during the nesting season, but was intense at most facilities. Chester et al. (1990) also found inconsistencies among distances between eagle perch sites and potential sources of disturbance in North Carolina. Eagle use of developed areas was less than expected on Chesapeake Bay, and areas of human activity were used significantly less than those without such activity (Buehler et al. 1991). Bald Eagles on the Columbia River avoided favored foraging sites when boats were present (McGarigal et al. 1991).

Foraging perch selection was influenced not only by site factors, but also by tree characteristics. As mean dbh and height of available trees increased among lakes, selection for size became less important. At McDonald, perches were shorter than controls but were closer to shore than at the other lakes. This may have been related to foraging behavior at McDonald, where eagles often captured suckers (*Catostomus* spp.) in near-shore shallows. Because the locations of these fish were predictable, the most important criterion for perch selection probably was nearness to accessible food rather than the more comprehensive view afforded by a taller, more distant perch. The positive correlation between height and percent screening may indicate a wider view from, and a clearer flight path to, the smaller perch trees. Grubb and Kennedy (1982) reported a similar relationship between perch height and surrounding vegetation for wintering Bald Eagles in the Southwest.

The preference for snags and dead-top and broken-top live trees is consistent with Stalmaster and Newman (1979), Hansen and Bartelme (1980), Steenhof et al. (1980), Grubb and Kennedy (1982), Biosystems Analysis (1985), and Fielder and Starkey (1986) who found that Bald Eagles favored snags and partly dead trees. These tree types tended to be large and open in structure, making them more desirable as perches. Chester et al. (1990) reported that eagle perch trees had more accessible perch limbs than did neighboring trees.

Black cottonwood and Douglas-fir may have been chosen for their consistently open branching structure and large size (Stalmaster and Newman 1979, Steenhof et al. 1980). Most of our observations were made when cottonwoods had leaves. Chester et al. (1990) found hardwoods were used significantly less than pines during seasons when leaves were present. Lodgepole pine had smaller than average dbh compared with all trees sampled. Due to a recent mountain pine beetle (*Dendroctanus monticolae*) outbreak, most lodgepole pines sampled (95%) were dead, probably contributing to their frequent use by eagles. Even among snags, however, lodgepole pine was preferred. Engelmann spruce was infrequently used overall, but among large live trees, it was a preferred species. Although Bald Eagles show a preference for live larch as roost trees (Crenshaw 1985), they were not used as perches in sampled sites. However, three of eight available larch snags or deadtops were used as perches. Overall, species selection was more important among totally live trees, probably because of greater structural variability.

Proximity to a food source often is the most important criterion for perch selection (Steenhof et al. 1980). Hansen and Bartelme (1980) and Fielder and Starkey (1986) suggested that availability of suitable perch types significantly influenced Bald Eagle distributions along winter foraging areas in Washington. Although eagles forage where perch selection is limited, a variety of perch types may facilitate foraging and provide alternate perches if disturbance occurs (McGarigal et al. 1991). During the nesting season, when food demands are high, the availability of preferred perch types at favored foraging sites (e.g., inlets and shallows of oligotrophic lakes) may influence territory and nest-site selection as well as nesting success.

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Habitat use by foraging Cattle Egrets in the Mexicali Valley, Baja California.—Most studies of habitat use and foraging behavior of Cattle Egrets (*Bubulcus ibis*) have focused on investigating whether egrets benefit more by foraging in association with cattle or by foraging alone (Heatwole 1965, Dinsmore 1973, Grubb 1976, Scott 1984). The association with cattle may be sufficiently important to confine breeding to areas near cattle (Telfair 1983:48). Besides foraging in areas with cattle, Cattle Egrets have shown preferences for short vegetation sites and irrigated meadows and have exploited a variety of foods (Siegfried 1971, Fogarty and Hetrick 1973). However, only a few studies have noted the importance of field conditions (e.g., amount of moisture, whether irrigated) on habitat use by Cattle Egrets (Dusi and Dusi 1968, Platter 1976:81, Siegfried 1978, Vermeulen and Spaans 1987), but the effect of field conditions on Cattle Egret foraging-habitat selection is not well known.